REMARKS

This amendment is in response to the Official Action dated January 15, 2003. The specification and drawings have been amended. Claims 3, 5 and 9 have been cancelled, Claims 1, 2, 4 and 6 have been amended. Claims 1, 2, 4, 6, 7, and 8 remain in the application with Claims 1, 4 and 6 being the only independent claims. Favorable reconsideration, in view of the above amendments and accompanying remarks, is respectfully requested.

In paragraph 4 of the Official Action, the Examiner requests affirmation of the provisional election made on December 19, 2002, during a telephone conference with Doug Pavelko, to prosecute Invention II, Claims 1, 2, 4, and 6-8 without traverse, Claims 3, 5 and 9 being withdrawn from further consideration. Affirmation of this election is hereby made and, as noted above, Claims 3, 5 and 9 have been cancelled.

In paragraph 6 of the Official Action, the Examiner objects to the drawings because according to the Examiner "Figure 2 (also Figure 1?) should be designated by a legend such as -- Prior Art -- because only that which is old is illustrated." Also, the Examiner notes that in the specification, on page 4 (lines 2-3) and page 5 (lines 3-5 and 8-10), it is noted that Figure 1 is referred to in light of both the present invention (page 5, lines 3-5) and also as conventional in the art (page 4, lines 2-3; and page 5, lines 8-10). It is believed that the above amendments to the drawings (adding the legend "Prior Art" to both Figs. 1 and 2), overcomes this objection. Also, it is pointed out that the specification has also been amended to refer that which is illustrated in Figs. 1 and as being "prior art".

In paragraph 7 of the Official Action, the Examiner objects to the drawings because "31" of Figure 1 does not have any lines/arrows that directly denote its particular structure ("31" is referred to in the specification as a door or access opening). It is believed that the above amendment to Fig. 1 which adds a lead line from reference character "31" to the door/access opening overcomes this objection.

In paragraph 8 of the Official Action, the Examiner requires a new title of the invention that is clearly indicative of the invention to which the claims are directed and suggest the title "METHOD FOR FILLING A MOLD". The title of the invention has been amended in such a manner.

In paragraph 9 of the Official Action, the Examiner objects to the disclosure because of the following informalities: on page 7, 7th and 8th lines, all 3 instances of "24" should be changed to "28". On page 13, line 22, "272" should be changed to "172". On page 20, line 21, it is believed that "time t" should be changed to "time t_2". The specification has been amended in such a manner. Thus, it is believed that these amendments to the specification overcome this objection.

In paragraph 10 of the Official Action, the Examiner objects to Claim 2 because the term "a" after "comprising" should either be deleted or replaced with "the step of". It is believed that the above amendment to Claim 2, replacing "a" after comprising with "the step of", overcomes this objection.

In paragraph 12 of the Official Action, the Examiner has rejected Claims 1, 2, 4 and 6-8 under the provisions of 35 U.S.C. 102(b) as being unpatentable over U.S. Patent No. 3,961,662 to Balevski et al. In paragraph 13 of the Official Action, the Examiner has rejected Claims 1, 2, 4 and 6-8 under the provisions of 35 U.S.C. 102(b) as being unpatentable over U.S. Patent No. 4,741,381 to Nishida et al. In paragraph 14 of the Official Action, the Examiner has rejected Claims 1, 2, 4 and 6-8 under the provisions of 35 U.S.C. 102(b) as being unpatentable over U.S. Patent No. 5,551,502 to Matsubayashi et al. In paragraph 15 of the Official Action, the Examiner has rejected Claims 1, 2, 4 and 6-8 under the provisions of 35 U.S.C. 102(b) as being unpatentable over applicants' admitted prior art (specification; and Figures 1 and 3). These rejections are respectfully traversed in light of the amendments to the claims.

As amended, Claim 1 defines the invention as a method for filling a mold between at least two time intervals using at least two different pressures to make a cast article. Claim 1 recites that the method comprises the steps of: (a) providing a molten metal to a casting chamber in fluid communication with the mold, the casting chamber having a supply conduit for introducing a gas into the casting chamber, and the casting chamber having an evacuation conduit for delivering the molten metal from the casting chamber to the mold; (b) controlling the filling of the mold during a first time interval by delivering the molten metal from the casting chamber to the mold at a first rate by supplying the gas to the casting chamber at a first pressure, the first pressure operative to move the molten metal from the casting chamber to the mold and to

impart a first kinetic energy to the molten metal, the first rate operative to produce a first stage actual fill profile; and (c) controlling the filling of the mold during a second time interval by delivering the molten metal from the casting chamber to the mold at a second rate by supplying the gas to the casting chamber at a second pressure which is greater than the first pressure, the second pressure operative to impart a second kinetic energy to the molten metal, the second kinetic energy of the molten metal being less than the first kinetic energy of the molten metal, the second rate operative to produce a second stage actual fill profile; wherein the filling of the mold decelerates from the first rate to the second rate, the second rate does not exceed the first rate, and the second rate is selected to enable the kinetic energy of the molten metal to be dissipated in a selectively controlled manner when the filling of the mold decelerates from the first rate to the second rate thereby reducing the turbulence in the filling of the mold with the molten metal during the change from the first rate to the second rate. None of the cited references discloses or suggests such a method for filling a mold as recited in Claim 1.

Specifically, U.S. Patent No. 3,961,662 to Balevski et al., U.S. Patent No. 4,741,381 to Nishida et al., U.S. Patent No. 5,551,502 to Matsubayashi et al. and applicants' admitted prior art (specification; and Figures 1 and 3) do not disclose or suggest explicitly or inherently alone or in combination nor make it obvious to one of ordinary skill in the art to practice the steps in Claim 1 of: (b) controlling the filling of the mold during a first time interval by delivering the molten metal from the casting chamber to the mold at a first rate by supplying the gas to the casting chamber at a first pressure, the first pressure operative to move the molten metal from the casting chamber to the mold and to impart a first kinetic energy to the molten metal, the first rate operative to produce a first stage actual fill profile; and (c) controlling the filling of the mold during a second time interval by delivering the molten metal from the casting chamber to the mold at a second rate by supplying the gas to the casting chamber at a second pressure which is greater than the first pressure, the second pressure operative to impart a second kinetic energy to the molten metal, the second kinetic energy of the molten metal being less than the first kinetic energy of the molten metal, the second rate operative to produce a second stage actual fill profile; wherein

the filling of the mold decelerates from the first rate to the second rate, the second rate does not exceed the first rate, and the second rate is selected to enable the kinetic energy of the molten metal to be dissipated in a selectively controlled manner when the filling of the mold decelerates from the first rate to the second rate thereby reducing the turbulence in the filling of the mold with the molten metal during the change from the first rate to the second rate, as recited in Claim 1. As discussed in the specification beginning on page 19, line 22, "It should be noted that the actual fill profile 256 of Fig. 4 and the prior art actual fill profile 116 of Fig. 3 differ in that the actual fill profile 256 of Fig. 4 does not "overshoot" its corresponding desired fill profile 240. Likewise, the actual fill profile 256 of Fig. 4 does not produce the "bounce" and turbulence illustrated and described above in connection with prior art Fig. 3. Without wishing to be bound by theory, it is believed that the filling method according to the present invention allows the *kinetic energy of the molten metal 16 to dissipate in the casting apparatus 10 in a selectively controlled manner. As a result of this, the turbulence is reduced in the filling of the mold 12 with the molten metal 16* according to the present invention" (emphasis added). Also, the specification discusses beginning on page 22, line 3 that "It should be noted that the actual fill profile 312 of Fig. 5 and the actual fill profile 116 of Fig. 3 differ in that the actual fill profile 312 of Figure 5 does not "overshoot" its corresponding desired fill profile 304. Likewise, the actual fill profile 312 of Fig. 5 does not produce the "bounce" and turbulence noted in Fig. 3. Without wishing to be bound by theory, it is believed that the filling method according to the invention allows the *kinetic energy of the molten metal 16 to dissipate in the casting apparatus 10 in a controlled manner. This reduces the turbulence in the filling of the mold 12 with the molten metal 16*" (emphasis added). None of the prior art references discloses or suggests a method for filling a mold wherein the second rate is selected to enable the "kinetic energy" of the molten metal to be dissipated in a selectively controlled manner when the filling of the mold decelerates from the first rate to the second rate thereby reducing the turbulence in the filling of the mold, as recited in Claim 1. Thus, it is believed that the method recited in Claim 1 is not disclosed or suggested by the cited references. Accordingly, it is

believed that Claim 1, along with dependent Claim 2, are patentable over the cited references.

Method Claim 4 has been amended in a manner similar to Claim 1. Thus, for those reasons discussed above with respect to Claim 1, it is believed that Claim 4 is patentable over the cited references.

Method Claim 6 has been amended in a manner similar to Claim 1. Thus, for those reasons discussed above with respect to Claim 1, it is believed that Claim 6, along with dependent claims 7 and 8, are patentable over the cited references.

In view of the above amendments and accompanying remarks, it is believed that the application is in condition for allowance.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION

Please replace the title of the invention on Page 1, Line 2 with the folllowing new title:

METHOD FOR FILLING A [CASTING APPARATUS] MOLD

Please replace the paragraph beginning on Page 5, Line 3, with the following new paragraph:

Referring now to Fig. 1, there is illustrated a prior art low pressure countergravity casting apparatus, indicated generally at 10, which can be used in accordance with the teachings of the present invention. Although this invention will be described and illustrated in conjunction with the particular low pressure countergravity casting apparatus 10 disclosed herein, it will be appreciated that this invention may be used in conjunction with other types of casting apparatus. The general structure and operation of the low pressure countergravity casting apparatus 10 is conventional in the art. Thus, only those portions of the low pressure countergravity casting apparatus 10 which are necessary for a full understanding of this invention will be explained and illustrated in detail.

Please replace the paragraph beginning on Page 5, Line 3, with the following new paragraph:

Referring now to prior art Figure 2, the inlet feed gate 28, the distribution port 90, and the adjacent mold cavity 24 are illustrated containing the molten metal 16. It will be appreciated that the volume V1 of the molten metal 16 in the inlet feed gate 28 is less than the volume V2 of the molten metal 16 in the distribution port 90 and the volume V3 of the molten metal 16 in the mold cavity 24. Thus, as the molten metal 16 passes through the inlet feed gate 28 from the port 90 into the mold cavity 24, turbulence can be produced.

Please replace the paragraph beginning on Page 7, Line 7, with the following new paragraph:

The casting apparatus 10 includes one or more inlet feed gates [24] 28 (only one of such inlet feed gates [24] 28 illustrated in Fig. 1). The inlet feed gates [24] 28 extend generally upwardly from a bottom side 26 of the mold 12 and are operative to establish fluid communication between the mold cavity 24 and the bottom side 26 of the mold 12. The inlet feed gates 28 of the mold 12 are supplied with the molten metal 16 from the casting chamber 46 through a feed tube 76. The inlet feed gates 28 are provided to aid in further processing of the cast article after the cast article has sufficiently cooled.

Please replace the paragraph beginning on Page 13, Line 3, with the following new paragraph:

At about the point 144, the molten metal 16 in the mold 12 "bounces" and creates turbulence in the molten metal 16 in the mold 12, (as also illustrated in prior art Figure 2). The molten metal 16 in the mold 12 reaches a relative peak at about a point 148 of the prior art actual fill profile 116, then drops to a trough at about a point 152. At about the point 152, the molten metal 16 in the mold 12 "bounces," and creates undesirable turbulence in the molten metal 16 in the mold 12. The molten metal 16 in the mold 12 reaches a relative peak at about a point 156 of the prior art actual fill profile 116, then drops to a trough at about a point 160. At about the point 160, the molten metal 16 in the mold 12 "bounces," and creates turbulence in the molten metal 16 in the mold 12. It should be noted that, though three troughs, the point 144, the point 152, and the point 160 are shown and discussed, the actual fill profile 116 may include a different number of troughs in stage 2.

Please replace the paragraph beginning on Page 13, Line 16, with the following new paragraph:

It will be appreciated that as the illustrated prior art actual fill profile 116 begins stage 3 at about the time t_2, the prior art actual fill profile 116 about approximates the prior art desired fill profile 112 at about a point 164 of the actual fill profile 116. At about a point 172 of the prior art desired fill profile 112, the pressure of the prior art actual fill profile 116 is less than that of the prior art desired fill profile 112. The controller 54 compensates at about a point [272] 172 by increasing the amount of fluid being added to the casting chamber 46. The amount of fluid being added to the casting chamber 46 is adjusted by the controller 54 such that the pressure of the prior art actual fill profile 116 is about the same as the pressure of the prior art desired fill profile 112 at the end of stage 3 at time t_3.

Please replace the paragraph beginning on Page 13, Line 16, with the following new paragraph:

The illustrated desired fill profile 304 can be divided into one or more filling stages, each filling stage corresponding to a selected time interval. Stage 1 of the desired fill profile 304 is illustrated. It should be understood that the invention may be practiced at any suitable stage of the desired fill profile 304. Between the time t_1 and the time t_2, the desired fill profile 304 indicates that the molten metal 16 is optimally moved at a first rate of pressure. Between the time t_2 and the time t_3, the desired fill profile 304 indicates that the molten metal 16 is optimally moved at a second rate of pressure. Between the time t_3 and the time t_4, the desired fill profile 304 indicates that the molten metal 16 is optimally moved at a third rate of pressure. It will be appreciated that a dotted line 308 is shown and is representative of how the molten metal 16 is moved at the first rate of pressure, if the desired fill profile 304 does not change at the time t_2. The dotted line is approximately collinear with the portion of the desired fill profile 304 between the time t_1 and the time t_2.

IN THE CLAIMS

Please cancel pending Claims 3, 5, and 9.

Please substitute the following amended Claims 1, 2, 4 and 6 for the pending claims of the same number:

1. (Amended) A method for filling a mold between at least two time intervals using at least two different pressures to make a cast article comprising the steps of:

(a) providing a molten metal to a casting chamber in fluid communication with the mold, the casting chamber having a supply conduit for introducing a gas into the casting chamber, and the casting chamber having an evacuation conduit for delivering the molten metal from the casting chamber to the mold;

(b) controlling the filling of the mold during a first time interval by delivering the molten metal from the casting chamber to the mold at a first rate by supplying the gas to the casting chamber at a first pressure, the first pressure operative to move the molten metal from the casting chamber to the mold and to impart a first kinetic energy to the molten metal, the first rate operative to produce a first stage actual fill profile; and

(c) controlling the filling of the mold during a second time interval by delivering the molten metal from the casting chamber to the mold at a second rate by supplying the gas to the casting chamber at a second pressure which is greater than the first pressure, the second pressure operative to impart a second kinetic energy to the molten metal, the second kinetic energy of the molten metal being less than the first kinetic energy of the molten metal, the second rate operative to produce a second stage actual fill profile[,];

wherein the filling of the mold decelerates from the first rate to the second rate, [and] the second rate does not exceed the first rate, and the second rate is selected to enable the kinetic energy of the molten metal to be dissipated in a selectively controlled manner when the filling of the mold decelerates from the first rate to the second rate thereby reducing the turbulence in the filling of the mold with the molten metal during the change from the first rate to the second rate.

2. (Amended) The method of claim 1 further comprising [a] the step of providing a controller for controlling the first rate and the second rate.

4. (Amended) A method for filling a mold to make a cast article comprising the steps of:

(a) providing a molten metal to a casting chamber, the casting chamber having a supply conduit for introducing a gas into the casting chamber, and the casting chamber having an evacuation conduit for delivering the molten metal from the casting chamber to the mold;

(b) providing a transducer and a controller;

(c) during a first time interval controlling the filling of the mold by introducing the gas into the casting chamber at a first rate by supplying the gas to the casting chamber at a first pressure, the first pressure operative to move the molten metal from the casting chamber to the mold and to impart a first kinetic energy to the molten metal, the first rate operative to produce a first stage actual fill profile; and

(d) during a second time interval controlling the filling of the mold by introducing the gas into the casting chamber at a second rate by supplying the gas to the casting chamber at a second pressure which is greater than the first pressure, the second pressure operative to impart a second kinetic energy to the molten metal, the second kinetic energy of the molten metal being less than the first kinetic energy of the molten metal, the second rate operative to produce a second stage actual fill profile[,];

wherein the transducer sends a signal representative of the pressure in the casting chamber and the controller changes the filling of the mold from the first rate to the second rate and wherein the filling of the mold decelerates from the first rate to the second rate, the second rate does not exceed the first rate, and the second rate is selected to enable the kinetic energy of the molten metal to be dissipated in a selectively controlled manner when the filling of the mold decelerates from the first rate to the second rate thereby reducing the turbulence in the filling of the mold with the molten metal during the change from the first rate to the second rate.

6. (Amended) A method for filling a mold to make a cast article comprising the steps of:

(a) providing a molten metal to a casting chamber, the casting chamber having a supply conduit for introducing a gas into the casting chamber, and the casting chamber having an evacuation conduit for delivering the molten metal from the casting chamber to the mold;

(b) providing a desired fill profile for delivering the molten metal from the casting chamber to the mold;

(c) detecting the pressure in the casting chamber;

(d) providing a controller and sending a signal representative of the pressure in the casting chamber to the controller; and

(e) changing the desired fill profile based upon the signal representative of the pressure in the casting chamber;

wherein the desired fill profile includes at least controlling the filling of the mold during a first time interval by delivering the molten metal from the casting chamber to the mold at a first rate by supplying the gas to the casting chamber at a first pressure, the first pressure operative to move the molten metal from the casting chamber to the mold and to impart a first kinetic energy to the molten metal, the first rate operative to produce a first stage actual fill profile, and controlling the filling of the mold during a second time interval by delivering the molten metal from the casting chamber to the mold at a second rate by supplying the gas to the casting chamber at a second pressure which is greater than the first pressure, the second pressure operative to impart a second kinetic energy to the molten metal, the second kinetic energy of the molten metal being less than the first kinetic energy of the molten metal, the second rate operative to produce a second stage actual fill profile, wherein the filling of the mold decelerates from the first rate to the second rate, the second rate does not exceed the first rate, and the second rate is selected to enable the kinetic energy of the molten metal to be dissipated in a selectively controlled manner when the filling of the mold decelerates from the first rate to the second rate thereby reducing the turbulence in the filling of the mold with the molten metal during the change from the first rate to the second rate.